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TRANSLATION

METHOD OF OBTAINING A HEAT-RESISTANT PARAMAGNETIC
POLYMER

By

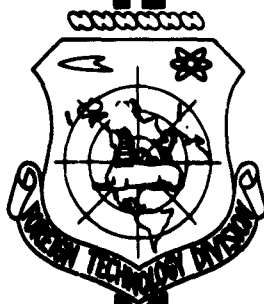
V. P. Parini and A. A. Berlin

FOREIGN TECHNOLOGY
DIVISION

AIR FORCE SYSTEMS COMMAND

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UNEDITED ROUGH DRAFT TRANSLATION

METHOD OF OBTAINING A HEAT-RESISTANT PARAMAGNETIC POLYMER

BY: V. P. Parini and A. A. Berlin

English Pages: 2

SOURCE: Soviet Patent Nr. 148517 (737748/23-4)
7 July 1961, pp 1

S/19-62-0-13

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WP-AFB, OHIO.

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Date 26 Feb 19 63

METHOD OF OBTAINING A HEAT-RESISTANT PARAMAGNETIC
POLYMER

V. P. Parini and A. A. Berlin

The familiar method for obtaining a heat-resistant paramagnetic polymer is the reaction of diamine with -p-benzoquinone or its halogen substitute which contains labile hydrogen or halogen atoms adjacent to the carboxylic oxygen.

The proposed method, compared to the familiar method, broadens the source of raw materials for obtaining a heat-resistant paramagnetic polymer. The distinguishing feature of this method is that aromatic diamine is subjected to reaction with quinone, free of labile hydrogen atoms adjacent to the keto group. The polymers thus obtained have increased heat resistance; their specific electrical conductance at 25° is 10^{-9} to 10^{-7} ohm⁻¹ cm⁻¹, with conductance energy of 0.25 to 0.3 ev.

Example 1. A mixture of 2.7 g (0.05 meta position) of phenylenediamine and 5.2 g (0.05 meta position) of anthraquinone is heated at 300° for 3 hours in a sealed ampoule in an inert atmosphere. The solid product of the reaction is crushed, washed by boiling alcohol,

dried, freed from the low-molecular-weight impurities, and kept at a temperature of 200° and a pressure of 10^{-3} mm for 2 hours. The obtained product is black powder which is insoluble in alcohol, acetone, dioxane, and xylene, and which is partly soluble in pyridine, dimethylformamide, and 98% sulfuric acid. The product yield is 5.9 g. At elevated temperatures the obtained paramagnetic polymer undergoes a weight loss: at 400° - 2%, at 500° - 4%, at 600° - 7.5%.

Example 2. A mixture of 2.3 g (0.025 meta position) of benzidine and 2.6 g (0.025 meta position) of anthraquinone is subjected to a reaction as in Example 1. We obtain 3.3 g of a black powder which is insoluble in alcohol, partly soluble in acetone and dioxane, almost completely soluble in pyridine, dimethylformamide, and sulfuric acid, and soluble in 98% sulfuric acid (the solutions have a green color).

Rigid films can be obtained on evaporation of the organic solvents from the solutions. The obtained paramagnetic polymer undergoes the following weight losses with elevated temperatures: at 300° - 2%, at 400° - 5%, and 500° - 8%.

Object of the Invention

The method of obtaining a heat-resistant paramagnetic polymer by the reaction of diamine with quinone has the distinguishing feature that in order to expand the raw materials, aromatic diamine is subjected to a reaction with quinone, free of labile hydrogen atoms adjacent to the keto group.

ORGANIC CHEMISTRY ASTIA

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1ST ANALYST 2/14

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ALKYL

210.1	01 0	ALKANES
3015.25	1	IC
1663.25	2	2C
3885.25	3	3C
0745.25	4	4C
3561.25	5	5C
2288.25	6	6C
2285.25	7	7C
3392.25	8	8C
3311.25	9	9C
1245.5	11	10C
0210.11	01 12	10+C
0210.14	02 0	TERMINAL
0210.12	1	NONTERMINAL
0210.13	2	POLY USAGE

ALKENES

0210.15	3	ALKENES
3015.5	4	=CH2
1663.75	5	C=C
3885.75	6	3C
0745.75	7	4C
3561.75	8	5C
2288.75	9	6C
2285.75	11	7C
3392.75	02 12	8C
3311.75	03 0	9C
1247.5	1	10C
0210.16	2	10+C
0210.20	3	TERMINAL
0210.17	4	NONTERMINAL
0210.18	5	POLY =
0210.19	6	POLY USAGE

ALKYNYL

0211.2	7	ALKYNES
3015.75	8	=C
0022.5	9	C≡C
3906.5	11	3C
0747.5	03 12	4C
3565.5	04 0	5C
0211.3	1	6+C
0211.7	2	TERMINAL
0211.4	3	NONTERMINAL
0211.5	4	POLY =
0211.6	5	POLY USAGE

ARYL

0570.10	6	BENZENE
0570.15	7	MONOSUB
0570.11	8	DISUB
0570.21	9	TRISUB
0570.16	11	ORTHO
0570.14	04 12	META
0570.17	05 0	PARA
0570.20	1	SYM-TRISUB
0570.19	2	POLYSUB
0570.13	3	IND
0570.12	4	FUSED
0570.18	5	POLY USAGE

CYCLOALKANES

1225.10	6	CYCLOALKANES
1225.11	7	3,4M
1225.12	8	5M
1225.13	9	6M
1225.14	11	7+M
1225.19	05 12	SAT
1225.21	06 0	UNSAT
1225.15	1	BICYCLO
1225.17	2	IND
1225.16	3	FUSED
1225.20	4	SPIRO
1225.18	5	POLY USAGE

HALOGENS

2214	6	HALOGENS
1883.2	7	F
0921.5	8	Cl
0724.5	9	Br
2586.5	11	I
0421	06 12	At
2214.5	07 0	POLY USAGE

CARBONYL

0803.7	1	CARBONYL
0803.2	2	C=O
1915.5	3	HC=O
5091.6	4	C=S
5091.30	5	HC=S
3468.25	6	O=(RING)
5090.11	7	S=(RING)
2982.5	8	MET. CARBONYLS
3461.5	9	$\begin{array}{c} \text{C} \\ \text{O} \\ \text{O} \end{array}$
0803.5	11	POLY USAGE
0803.4	07 12	MISC.

COOR

0804.3	08 0	COOR
0804.1	1	-COO-ESTER
0804.2	2	COOH
0804.7	3	CARBOXY HALIDES
0804.6	4	F-C=O
0804.5	5	Cl-C=O
0804.4	6	Br-C=O
0804.8	7	I-C=O
0804.9	8	OCOO
0182.5	9	$\begin{array}{c} \text{O} \\ \text{C} \\ \text{O} \end{array}$
0805.25	11	METAL SALT
0805.75	08 12	POLY USAGE
0805.5	09 0	MISC.

S-COOR

5090.15	1	S-COOR
5090.12	2	THIO ACIDS (CXXH)
5091.5	3	S=C-O
5091.4	4	O=C-S
5090.22	5	-S-COOH
5090.20	6	S=C-HALOGEN
5090.17	7	S=C-Br
5090.15	8	S=C-Cl
5090.19	9	S=C-F
5090.21	11	S=C-I
5090.14	09 12	POLY USAGE
5090.13	10 0	MISC.

S-HETERO

4863.10	1	S-HETERO
4863.14	2	3, 4M
4863.15	3	5M
4863.16	4	6M
4863.17	5	7+M
4863.21	6	O-CONT.
4863.20	7	N-CONT.
4863.22	8	OTHER-CONT.
4863.11	9	IS
4863.12	11	2S
4863.12	10 12	3+S
4863.19	11 0	IND
4863.18	1	FUSED
4863.24	2	SPIRO
4863.23	3	POLY USAGE

N-HETERO

3298.10	4	N-HETERO
3298.14	5	3, 4M
3298.15	6	5M
3298.16	7	6M
3298.17	8	7+M
3298.20	9	O-CONT.
3298.23	11	S-CONT.
3298.21	11 12	OTHER-CONT.
3298.12	12 0	IN
3298.12	1	2N
3298.13	2	3+N
3298.24	3	SALT
3298.19	4	IND
3298.18	5	FUSED
3298.25	6	SPIRO
3298.22	7	POLY USAGE

O-HETERO

3475.10	8	O-HETERO
3475.13	9	3, 4M
3475.14	11	5M
3475.15	12 12	6M
3475.16	13 0	7+M
3475.19	1	N-CONT.
3475.22	2	S-CONT.
3475.20	3	OTHER-CONT.
3475.11	4	I-O
3475.12	5	2+O
3475.18	6	IND
3475.17	7	FUSED
3475.23	8	SPIRO
3475.21	9	POLY USAGE

N, C, S

3297.5	11	N,C,S
5090.16	13 12	=N-C=S
1398.75	14 0	-N-C(-S)-S
5091.7	1	=N-C(=S)-NE
5091.20	2	-S-CN
2618.5	3	-N=C=S
3297.7	4	POLY USAGE
3297.6	5	MISC.

N, C, O

3297.2	6	N,C,O
4462.5	7	NC(=O)-N-N
0785.25	8	-N-C(=O)-O-
5361.5	9	=N-C(=O)-N=
0785.75	11	-C(=O)-N-
2613.25	14 12	-N=C=O
1222.5	15 0	-O-CN
3297.4	1	POLY USAGE
3297.3	2	MISC.

C, N

0797.25	3	C,N
1223.5	4	CN
2613.75	5	-N=C
0239.2	6	-N-C≡N
2150.5	7	-N-C(=N)-N-
0787.5	8	-N=C=N-
0797.75	9	POLY USAGE
0797.5	11	MISC.

OH, SH

2391.6	15 12	OH, SH
2391.4	16 0	OH
2968.25	1	SH
2391.8	2	POLY USAGE

N, O, (S)

3298.27	3	N,O (S)
2391.2	4	=N-OH
2968.75	5	=N-SH
3295.5	6	NO2
3299.75	7	-N=O
3299.25	8	-N-N=C
3289.5	9	N-NO2
3298.29	11	POLY USAGE
3298.27	16 12	MISC.

S, O, (N)

4863.25	17 0	S, O (N)
4860.75	1	O=S=O
4860.25	2	SO3H
4859.5	3	S=O
4860.5	4	SO2-N
4863.27	5	POLY USAGE
4863.26	6	MISC.

O, S

3468.75	17 12	O, S
3587.5	1	
5090.10	2	
1398.25	3	
5257.5	4	
3475.28	5	

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S - HETERO		
4863.10	1	S-HETERO
4863.14	2	3, 4M
4863.15	3	5M
4863.16	4	6M
4863.17	5	7+M
4863.21	6	O-CONT.
4863.20	7	N-CONT.
4863.22	8	OTHER-CONT.
4863.11	9	IS
4863.12	11	2S
4863.12	10 12	3+S
4863.19	11 0	IND
4863.18	1	FUSED
4863.24	2	SPIRO
4863.23	3	POLY USAGE
N - HETERO		
3298.10	4	N-HETERO
3298.14	5	3, 4M
3298.15	6	5M
3298.16	7	6M
3298.17	8	7+M
3298.20	9	O-CONT.
3298.23	11	S-CONT.
3298.21	11 12	OTHER-CONT.
3298.12	12 0	IN
3298.12	1	2N
3298.13	2	3+N
3298.24	3	SALT
3298.19	4	IND
3298.18	5	FUSED
3298.25	6	SPIRO
3298.22	7	POLY USAGE
O - HETERO		
3475.10	8	O-HETERO
3475.13	9	3, 4M
3475.14	11	5M
3475.15	12 12	6M
3475.16	13 0	7+M
3475.19	1	N-CONT.
3475.22	2	S-CONT.
3475.20	3	OTHER-CONT.
3475.11	4	I-O
3475.12	5	2+O
3475.18	6	IND
3475.17	7	FUSED
3475.23	8	SPIRO
3475.21	9	POLY USAGE

N, C, S		
3297.5	11	N,C,S
5090.16	13 12	-N-C-S
1398.75	14 0	-N-C(=S)-S
5001.7	1	-N-C(=S)-NE
5001.20	2	-S-CN
2618.5	3	-N=C=S
3297.7	4	POLY USAGE
3297.6	5	MISC.

N, C, O		
3297.2	6	N,C,C
4462.5	7	NC(=O)-N-N
0785.25	8	-N-C(=O)-O-
5361.5	9	-N-C(=O)-N-
0785.75	11	-C(=O)-N-
2613.25	14 12	-N-C=O
1222.5	15 0	-O-CN
3297.4	1	POLY USAGE
3297.3	2	MISC.

C, N		
0797.25	3	C,N
1223.5	4	CN
2613.75	5	-N=C
0239.2	6	-N-C=N
2150.5	7	-N-C(=N)-N-
0787.5	8	-N=C=N-
0797.75	9	POLY USAGE
0797.5	11	MISC.

OH, SH		
2391.6	15 12	OH, SH
2391.4	16 0	OH
2968.25	1	SH
2391.8	2	POLY USAGE

N, O, (S)		
3298.27	3	N,O (S)
2391.2	4	-N-OH
2968.75	5	-N-SH
3295.5	6	NO2
3299.75	7	-N=O
3299.25	8	-N=N=C
3289.5	9	N-NO2
3298.29	11	POLY USAGE
3298.27	16 12	MISC.

S, O, (N)		
4863.25	17 0	S, O (N)
4860.75	1	O=S=O
4860.25	2	SO3H
4859.5	3	S=O
4860.5	4	SO2-N
4863.27	5	POLY USAGE
4863.26	6	MISC.

O, S		
3468.75	7	O,S
3587.5	8	-O-
5090.10	9	-O-O-
1398.25	11	-S-
5257.5	17 12	-S-S-
3475.28	18 0	-S-S-S-
	1	POLY USAGE
	2	MISC.

AMINES		
0239.5	3	AMINES
3852.5	4	NH2- (PRI)
4442.5	5	-NH- (SEC)
5036.5	6	-N= (TER)
3984.5	7	-N= (QUAT)
2442.5	8	=N
0503.5	9	-N=N-
1329.5	11	N=N (N=N=)
2359.5	18 12	-N-N-
5251.5	19 0	N-N=N-
0501.5	1	N=N
1883.4	2	FLUOROAMINES
1883.8	3	-NF2
1883.6	4	-NF
1884.5	5	F2N-NF-
0239.5	6	SALT (NON-QUAT)
0239.9	7	POLY USAGE
0239.7	8	MISC.

PHOSPHORUS		
3634.2	9	PHOSPHORUS RAD.
3634.16	11	P=O,S,O
3634.18	19 12	P=S,2O
3634.17	20 0	P=O, S, 2O
3634.19	1	S=PO3
3634.15	2	S=P-F
3634.14	3	S=P-F
3634.11	4	O=P(N) (O)-F
3634.10	5	O=P, (F), 2N
3634.13	6	O=P(F) O2
3634.12	7	O=P-F
3634.23	8	P,S-(I TO 3S)
3634.24	9	P,S-(4S)
1224.75	11	CYCLIC P
3632.25	20 12	P(+3)
3632.75	21 0	P(+5)
3617.5	1	PO4
3634.21	2	P-MISC.
3634.25	3	P,S-MISC.
3634.22	4	POLY USAGE

0687	5	BORANES
4530	6	SILANES

MISCELLANEOUS		
22	23	
0	0	
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
11	11	
12	12	

METALS AND METALLOIDS		
2140	24 0	GROUP I
0205	1	ALKALI
0877	2	Cs
1925	3	Fa
2787	4	Li
3806	5	K
4592	6	Na
4365	7	Ra
1134	8	Cu
2102	9	Au
4542	11	Ag

2141	24 12	GROUP II
0208	25 0	ALKALINE
0536	1	Ba
0573	2	Be
0760	3	Ca
2845	4	Mg
4110	5	Ra
4821	6	Sn
0755	7	Co
0970	8	Hg
5585	9	Zn

2142	11	GROUP III
0043	25 12	Ac
0232	26 0	Al
1996	1	Ga
2467	2	In
2707	3	La
4410	4	Sc
5055	5	Tl
5583	6	Y

2143	7	GROUP IV
2072	8	Ge
2201	9	Hf
2719	11	Pb
5128	26 12	Sn
5139	27 0	Ti
5590	1	Zn

2144	2	GROUP V
0330	3	Sb
0610	4	Bi
3287	5	Nb
	6	P
4956	7	Ta
5381	8	V

2145	9	GROUP VI
0883	11	CHALCOGENS
3781	27 12	Po
4457	28 0	Sr
0935	1	Cn
3122	2	Mo
5277	3	W

2146	4	GROUP VII
5223	5	TRANS. ELEM.
0992	6	Co
2604	7	In
2607	8	Fe
3276	9	Ni
3456	11	Os
3492	28 12	Pd
3744	29 0	Pt
4277	1	Rh
4373	2	Ru



FRAGMENT RELATIONSHIPS

ALKYL 30 0 ARYL 1 CYCLOALKYL 2 HALOGENS 3 CARBONYL 4 COOR 5 S-COOR 6 S-HETERO 7 N-HETERO 8 O-HETERO 9 N,C,S 11 N,C,O 30 12 C,N 31 0 N,O (S) 1 OH, SH 2 S,O (N) 3 O,S 4 AMINES 5 PHOSPHORUS 6 METALS 7 BORANES 8 SILANES 9 MISC.	ALKENYL 11 ARYL 31 12 CYCLOALKYL 32 0 HALOGENS 1 CARBONYL 2 COOR 3 S-COOR 4 S-HETERO 5 N-HETERO 6 O-HETERO 7 N,C,S 8 N,C,O 9 C,N 11 N,O (S) 32 12 OH, SH 33 0 S,O (N) 1 O,S 2 AMINES 3 PHOSPHORUS 4 METALS 5 BORANES 6 SILANES 7 MISC.	ALKYNYL 8 ARYL 9 CYCLOALKYL 11 HALOGENS 33 12 CARBONYL 34 0 COOR 1 S-COOR 2 S-HETERO 3 N-HETERO 4 O-HETERO 5 N,C,S 6 N,C,O 7 C,N 8 N,O (S) 9 OH, SH 11 S,O (N) 34 12 O,S 35 0 AMINES 1 PHOSPHORUS 2 METALS 3 BORANES 4 SILANES 5 MISC.	ARYL 6 ARYL 7 CYCLOALKYL 8 HALOGENS 9 CARBONYL 11 COOR 35 12 S-COOR 36 0 S-HETERO 1 N-HETERO 2 O-HETERO 3 N,C,S 4 N,C,O 5 C,N 6 N,O (S) 7 OH, SH 8 S,O (N) 9 O,S 11 AMINES 36 12 PHOSPHORUS 37 0 METALS 1 BORANES 2 SILANES 3 MISC.	CYCLOALKYL 4 CYCLOALKYL 5 HALOGENS 6 CARBONYL 7 COOR 8 S-COOR 9 S-HETERO 11 N-HETERO 37 12 O-HETERO 38 0 N,C,S 1 N,C,O 2 C,N 3 N,O (S) 4 OH, SH 5 S,O (N) 6 O,S 7 AMINES 8 PHOSPHORUS 9 METALS 11 BORANES 38 12 SILANES 39 0 MISC.	HETERO 11 ARYL 31 12 CYCLOALKYL 32 0 HALOGENS 1 CARBONYL 2 COOR 3 S-COOR 4 S-HETERO 5 N-HETERO 6 O-HETERO 7 N,C,S 8 N,C,O 9 C,N 11 N,O (S) 32 12 OH, SH 33 0 S,O (N) 1 O,S 2 AMINES 3 PHOSPHORUS 4 METALS 5 BORANES 6 SILANES 7 MISC.
S-HETERO 44 0 S-HETERO 1 N-HETERO 2 O-HETERO 3 N,C,S 4 N,C,O 5 C,N 6 N,O (S) 7 OH, SH 8 S,O (N) 9 O,S 11 AMINES 44 12 PHOSPHORUS 45 0 METALS 1 BORANES 2 SILANES 3 MISC.	N-HETERO 4 N-HETERO 5 O-HETERO 6 N,C,S 7 N,C,O 8 C,N 9 N,O (S) 11 OH, SH 45 12 S,O (N) 46 0 O,S 1 AMINES 2 PHOSPHORUS 3 METALS 4 BORANES 5 SILANES 6 MISC.	O-HETERO 7 O-HETERO 8 N,C,S 9 N,C,O 11 C,N 46 12 N,O (S) 47 0 OH, SH 1 S,O (N) 2 O,S 3 AMINES 4 PHOSPHORUS 5 METALS 6 BORANES 7 SILANES 8 MISC.	N,C,S 9 N,C,S 11 N,C,O 47 12 C,N 48 0 N,O (S) 1 OH, SH 2 S,O (N) 3 O,S 4 AMINES 5 PHOSPHORUS 6 METALS 7 BORANES 8 SILANES 9 MISC.	N,C,O 11 N,C,O 48 12 C,N 49 0 N,O (S) 1 OH, SH 2 S,O (N) 3 O,S 4 AMINES 5 PHOSPHORUS 6 METALS 7 BORANES 8 SILANES 9 MISC.	O,S 52 0 O,S 6 AMINES PHOSPHORUS 7 METALS 8 BORANES 9 SILANES 11 MISC.
AD 74 75 76 77 78 79 80 4 0 0 5 4 5	AMINES 52 12 PHOSPHORUS 53 0 METALS 1 BORANES 2 SILANES 3 MISC.	PHOSPHORUS 53 0 PHOSPHORUS 4 METALS 5 BORANES 6 SILANES 7 MISC.	PHOSPHORUS 53 0 PHOSPHORUS 4 METALS 5 BORANES 6 SILANES 7 MISC.		

RING SYSTEM (GENERAL)

4292, 2	6 RINGS-2
4292, 4	7 RINGS-3
4292, 5	8 RINGS-4
4292, 7	9 RINGS-5
4292, 9	11 RINGS-6+
3298, 29	54 12 N-RINGS-1
3298, 30	55 0 N-RINGS-2
3298, 31	1 N-RINGS-3+
4863, 28	2 S-RINGS-1
4863, 29	3 S-RINGS-2+
3475, 24	4 O-RINGS-1
3475, 25	5 O-RINGS-2+
3089, 25	6 MISC. -HETERO RINGS-1
3089, 75	7 MISC. -HETERO RINGS-2

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	ARYL	CYCLOALKYL	HALOGENS	CARBONYL	S-COOR	COOR
ARYL	6 ARYL 7 CYCLOALKYL 8 HALOGENS 9 CARBONYL 11 COOR 35 12 S-COOR 36 0 S-HETERO 1 N-HETERO 2 O-HETERO 3 N,C,S 4 N,C,O 5 C,N 6 N,O(S) 7 OH, SH 8 S,O(N) 9 O,S 11 AMINES 36 12 PHOSPHORUS 37 0 METALS 1 BORANES 2 SILANES 3 MISC.	4 CYCLOALKYL 5 HALOGENS 6 CARBONYL 7 COOR 8 S-COOR 9 S-HETERO 11 N-HETERO 37 12 O-HETERO 38 0 N,C,S 1 N,C,O 2 C,N 3 N,O(S) 4 OH, SH 5 S,O(N) 6 O,S 7 AMINES 8 PHOSPHORUS 9 METALS 11 BORANES 38 12 SILANES 39 0 MISC.	1 HALOGENS 2 CARBONYL 3 COOR 4 S-COOR 5 S-HETERO 6 N-HETERO 7 O-HETERO 8 N,C,S 9 N,C,O 11 C,N 12 N,O(S) 39 OH, SH 40 0 S,O(N) 1 O,S 2 AMINES 3 PHOSPHORUS 4 METALS 5 BORANES 6 SILANES 7 MISC.	CARBONYL 8 COOR 9 S-COOR 11 S-HETERO 40 12 N-HETERO 41 0 O-HETERO 1 N,C,S 2 N,C,O 3 C,N N,O(S) OH, SH 4 S,O(N) O,S AMINES 5 PHOSPHORUS 6 METALS 7 BORANES 8 SILANES 9 MISC.	11 COOR 41 12 S-COOR 42 0 S-HETERO 1 N-HETERO 2 O-HETERO 3 N,C,S N,C,O C,N N,O(S) OH, SH S,O(N) 4 O,S 5 AMINES 6 PHOSPHORUS 7 METALS 8 BORANES 9 SILANES 11 MISC.	S-COOR 42 12 S-HETERO 43 0 N-HETERO 1 O-HETERO 2 N,C,S 3 N,C,O 4 C,N N,O(S) OH, SH S,O(N) 5 O,S 6 AMINES 7 PHOSPHORUS 8 METALS 9 BORANES 11 SILANES 43 12 MISC.
	N,C,S	N,C,O	C,N	N,O(S)	OH, SH	S,O(N)
	9 N,C,S 11 N,C,O 47 12 C,N 48 0 N,O(S) 1 OH, SH 2 S,O(N) 3 O,S 4 AMINES 5 PHOSPHORUS 6 METALS 7 BORANES 8 SILANES 9 MISC.	11 N,C,O 48 12 C,N 49 0 N,O(S) 1 OH, SH 2 S,O(N) 3 O,S 4 AMINES 5 PHOSPHORUS 6 METALS 7 BORANES 8 SILANES 9 MISC.	11 C,N 49 12 N,O(S) 50 0 OH, SH 1 S,O(N) 2 O,S 3 AMINES 4 PHOSPHORUS 5 METALS 6 BORANES 7 SILANES 8 MISC.	N,O(S) OH, SH 9 S,O(N) O,S 11 AMINES 50 12 PHOSPHORUS 51 0 METALS 1 BORANES 2 SILANES 3 MISC.	51 4 OH, SH S,O(N) O,S 5 AMINES 6 PHOSPHORUS 7 METALS 8 BORANES 9 SILANES 11 MISC.	S,O(N) 51 12 O,S 52 0 AMINES 1 PHOSPHORUS 2 METALS 3 BORANES 4 SILANES 5 MISC.
	AMINES	PHOSPHORUS	METALS	BORANES	SILANES	MISC.
	AMINES 52 12 PHOSPHORUS 53 0 METALS 1 BORANES 2 SILANES 3 MISC.	53 PHOSPHORUS 4 METALS 5 BORANES 6 SILANES 7 MISC.	8 METALS 9 BORANES 11 SILANES 53 12 MISC.	54 0 BORANES 1 SILANES 2 MISC.	54 3 SILANES 4 MISC.	54 5 MISC.

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